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Horticulture in Afghanistan: Challenges and Opportunities

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Horticulture has always been of fundamental importance to the Afghan economy; it has played a central role in the past and is still very important for a stable and thriving society. Despite the fact that only 12% of Afghanistan's total land is arable and only about 6% is currently cultivated, Afghanistan's climatic conditions are highly favorable for many tree crops, vegetable species, and seed production. During the 1960s, Afghanistan was the world leader in raisin production, and during the 1960s and 1970s, the export of high-value horticultural products accounted for 48% of annual export revenue in Afghanistan. In the 1970s, annual exports averaged around US$600 million, of which 30% was dried fruits and 70% was fresh fruits. It is estimated that income derived from horticultural products was three to seven times that of wheat. However, the last few decades of conflicts has caused widespread destruction of agricultural infrastructure, especially to orchards, and irrigation systems. The rebuilding of horticulture will allow Afghanistan to rise once again and provide abundant employment opportunities and livelihoods for up to 80% of its population. This will result in a better economy and increased food security. The re-establishment of horticulture should focus on good quality products with increased production. Developing modern horticulture in Afghanistan, with all its components and elements, will be a significant challenge; nevertheless, it has great potential to contribute to the redevelopment of the economy in Afghanistan.

Key words: annual export, climate, instability, potential, resources

Introduction

Afghanistan is a landlocked country of plains and mountains that lies between 29°40′ and 38°40′N and 60°31′ and 75 00′E. Afghanistan is partially in southern Asia and partially in central Asia. It has a total area of about 650,000 km^2. The Hindu Kush Mountains, nearly 1000 km long, split the country into north and south. The highest point is Nowshak (7485 m a.s.l) in Badakhshan province and the lowest point is Amu Darya (258 m a.s.l). Afghanistan has a mostly subarctic mountainous climate with dry and cold winters, except in the lowlands, which have an arid- to semi-arid climate. It has clearly defined seasons with hot summers and cold winters. Temperatures during the day may range from freezing at dawn to nearly 40℃ at noon. Summer temperatures can reach as high as 54℃ (in Zarang). The lowest temperature recorded was −54℃ (in Shark/Ghor province). About 80 % of the precipitation falls from October to April (The World Bank group, 2015). The desert areas receive less than 100 mm a year but the mountains receive more than 1000 mm, mostly as snow (Saidajan, 2012).

The country can be divided in to three distinct regions: the central highlands, the southern plateau, and the northern plains. The central area has deep narrow valleys and high mountains. This area has a relatively dry climate with cold winters, and warm summers. The southern plateau consists of a high plateau and sandy deserts with several rivers passing through. This area is prone to sand storms and has a dry climate. The northern plains are fertile, and are supplied by the

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Amu River. This area is an agricultural center.

The climate of Afghanistan varies greatly depending on which area of the country is being considered. In general, Afghanistan has extremely cold winters and hot summers. It is a typical semi-arid steppe climate, with many regional variations.

Up to 18 million people in Afghanistan live on less than US$2 a day and are considered food-insecure. Afghanistan would have great potential to ensure food security for its estimated 27 million people if donors invested in agricultural infrastructure, or if the more than 190,000 ha of poppies were converted to wheat production (The Inside Story on Emergencies, 2015).

The impression that one gets from outside is that Afghanistan is a mountainous and hilly country that does not grow any crops, but in fact the northern part is highly fertile whereas western, southern and north eastern parts also have some areas which are significantly fertile.

Main fruits grown in Afghanistan

According to FAO (2004) it has been shown that grape, followed by apples and almonds, pomegranates and apricots represents the highest percentage of orchard area all over the country. However in the east of the country (Nangarhar province) farmers grow subtropical tress (mainly orange trees) due to the suitable climatic conditions. Kandahar, Balkh, Nimroz and Kapisa are the provinces where pomegranates are grown with their valuable native varieties.

As mentioned above that grape and apple are the main grown fruits which also has economic importance; following is the brief information.

Grapes

Grapes are the primary fruit species being produced in the country, accounting for 48% of the total fruit growing area, where the total fruit growing area is 1.5 percent of the total area of cultivation (Central Statistics Organization (CSO), Afghanistan, 2012). However this figure fluctuates significantly from district to district. Further, due to unstable market prices and a dramatic reduction in the number of grape drying houses, many farmers are obliged to sell their production of fresh grapes in a short period of the season but, raisins can be stored and sold many months later.

Afghan farmers dry 20 to 25% of their grape harvest for raisin production. However the percentage of grapes dried differs greatly by region and year. Famers in Faryab and Sar-e pul may dry as much as 50% of their grape product; whereas farmers in Uruzgan, Samangan and Balkh province may dry about 10% of their grape harvest (Bunnel and Safi, 2013).

Many farmers sell their produce as fresh grapes, but with minimal benefit because local fresh markets are saturated at the time of grape harvesting and this greatly decreases prices. However if the facilities for the storage or transportation to foreign countries were present then the situation would be opposite. Most vineyards use some form of a training system, and in the case of the espalier system, pruning is not practiced regularly. The traditional technique takes 60 days to produce raisins. However, if the grapes are dipped in a solution of potassium carbonate, the drying time could be reduced to 8 days.

Apples

Afghanistan has favorable climatic conditions for the production of apples. Apples are still an important fruit in the country despite unfavorable conditions like lack of storage facilities, packaging and transportation problems thus limiting the domestic market. The more accessible areas and local markets have heavy competition with imported apples from Iran and Pakistan; nevertheless, cultivation is still widespread and mainly aimed at satisfying the small rural local market.

Challenges and opportunities

1. Challenges

Horticulture in Afghanistan faces many challenges because most growers left their farms during the ongoing conflicts. Those who migrated to safe places were no longer able to practice Horticulture, and they changed their professions. After people returned to the country and started practicing horticulture once again, many years later, many had forgotten their previous skills or lacked experience and knowledge. The main challenges facing horticulture are as follows:

1.1 Unstable marketing

"Dixie (1989) gave the following two definitions of marketing. 'The series of services involved in moving a product (commodity) from the point of production to the point of consumption.' 'Marketing involves finding out what your customers want and supplying it to them at a profit" (Thompson, 2003).

In many countries, the production of fresh fruit is currently lower than the market requirement. This normally results in a seller's market where the farmer

can sell all of the crop that is grown, and there may be little incentive to supply high-quality crops to the market. This frequently happens in less developed countries.

In other societies, crop production or potential crop production is greater than the demand. The effect of this in European markets has not necessarily reduced the price of the crops as might have been expected, but has increased the quality of the crops being offered to the consumer. In industrialized countries, the farmer is increasingly studying the market to determine its requirements.

Where markets are not well regulated, this has led to fluctuation in supplies of crops such as vegetables. This is because the farmer may see a particular crop is commanding a high price on the market because of undersupply. When the farmer changes his production to this crop, other farmers see the same opportunity and also change, resulting in an oversupply. This can lead to low prices and farmers stopping growing that plant, leading to a shortage, and the cycle repeats itself (Thompson, 2003).

The export department of the Ministry of Commerce of Afghanistan used to provide market information to traders and establish export quality criteria. The Agriculture Bank of Afghanistan and some cooperatives also provided market information to farmers. However these services were disrupted by the war, and nowadays traders and farmers have no access to any kind of centralized market information (FAO, 2004). As a result, farmers often refer to the previous year's market prices when planning for next year's production. This can lead to high volatility in the production and in prices of products from one year to another.

1.2 Storage

Storage of fruits and vegetables is practiced for various reasons. It is part of orderly marketing: where the storage period is usually short, storage allows for accumulation of sufficient produce by a grower to send to market. Also, the product may be stored when the price at a particular time is low, to await an increase in price. The price of agricultural products increases during the course of a normal storage season. This normal seasonal price increase makes it desirable for growers to devise a means of delaying their marketing to obtain the higher price. However, the cost of storage and any loss from decay of fruit and vegetables during storage must be less than the increase in price return at the time of marketing. In the overall picture, storage has three chief advantages:

a. It provides a means of holding the product in good condition for a long time, thus permitting orderly distribution of the crop and preventing gluts on the market.
b. It allows orderly distribution of products, which tends to stabilize prices.
c. It makes available a continuous supply of high-quality products to the consumer.

1.3 Packaging

Fruit must be handled carefully to protect it against damage. The function of packaging is primarily to contain and protect the produce. With fresh fruits and vegetables, there are often two levels of packaging. The first is the pack in which the produce is offered to the consumer, and the second is the pack that contains the consumer pack and is used to transport the product to the retail market. The package also helps to enhance the value of produce and help its sale. Packaging also helps to prevent mechanical injuries and provide easy handling. In Afghanistan, transport containers are often inappropriate, causing severe bruising of produce. Straw is often used as packaging material.

There is no packaging standard for horticultural products in Afghanistan. However, packaging is a crucial issue because most horticultural products are fragile and highly perishable. 49% of the villages in Afghanistan pack their horticultural products in jute sacks, 36% pack in crates (mostly for fruit species); and 15% pack in baskets (mostly pomegranates) (FAO, 2004).

1.4 Processing

Processing includes the treatments which start after harvest and end before consumption: handling, transportation, refrigeration, holding, washing, freezing, canning, drying, packaging, storage, and ultimately cooking or heating; however other processes maybe included.

Changes in the composition of fruits that decrease their nutritional value can occur after harvest during transportation, handling, processing, and distribution. After harvest, fruits and vegetables are still physiologically active. Enzymatic and respiratory processes may bring profound changes unless they can be controlled. In general, the lower the temperature at which a commodity is stored, the less likely it is to develop abnormalities.

2. Opportunities

The rehabilitation of agriculture especially horticulture is a central condition for socioeconomic development, poverty reduction, preventing environmental destruction, and reducing violence (De Soysa *et al*., 1999) as well as for providing food security. So the regeneration of the agricultural economy is fundamental to any recovery, as agriculture is the dominant occupation in poorer developing countries such as Afghanistan. It is well recognized that agriculture is also potentially the engine of rural growth, and agricultural research plays a crucial role in providing innovations necessary for such growth and development (Erskine and Nesbitt, 2009). Afghanistan has much potential and many opportunities to rise once again, and produce good quality horticultural products, not only for domestic use but also for export to neighbors and more distant countries. This will help Afghanistan take steps toward sustainable horticulture and the development of a viable economy.

2.1 Horticulture potential of Afghanistan

Horticulture is one of the areas of greatest opportunities in war-torn Afghanistan. Afghanistan has a long horticultural tradition and a reputation for high-quality produce. Nevertheless, chaos and continuous warfare has destroyed much of its potential. In 1972, horticultural commodities supplied 40 to 60% of all export earnings. Dried fruits from Afghanistan once accounted for 60% of the world's market. Horticultural production is now estimated at less than 30% of 1978 levels (Kemal-ur-Rahim, 2003). Many fields were abandoned and many orchards were destroyed; tree nurseries and seed sources, irrigation systems, and knowledge are limited and ineffective.

Afghanistan's environmental conditions are highly favorable for many fruits, and seed production. There is a large number of endemic horticultural species, while the wide range of agro-ecological zones provides a long season of constant supply. Afghanistan is a unique center of genetic diversity and is of great value to the international horticulture community. Carrot, radish, cherry, plum, apricot, peach, pear, apple, walnut, pistachio, fig, grape, pomegranate, melon, and almond are among the species present across the country, and likely provide a unique array of useful agro-botanical traits. Many of these crops are relatively water-efficient, contribute to significant production diversification, and are a source of much needed nutrients for the population. Horticulture is land- and labor-intensive, which is an advantage for poor farmers and share croppers. Cottage industries capable of processing of horticultural products would generate income for women and families. Considering the regional reputation for high-quality produce and the expanding global opportunities, horticulture can once again become an important source of export earnings (Future Harvest Consortium to Rebuild Agriculture in Afghanistan, 2003).

2.2 Water resources

Although Afghanistan has large areas of desert, it is still rich in water resources, mainly due to high, snow-covered mountains such as the Wakahan, Hindu Kush, and Baba mountains. Over 80% of Afghanistan's water resources have their origins in the Hindu Kush mountain ranges, with an altitude of more than 2000 m a.s.l., which functions as a natural storage of water in the form of snow during the winter and thus supports a perennial flow in all major rivers caused by snow melt during the summer.

Recent estimates indicate that Afghanistan has $75\times10^9\,m^3$ of renewable water, of which $55\times10^9\,m^3$ is surface water and $20\times10^9\,m^3$ is ground water. The annual volume of water used for irrigation is estimated to be $20\times10^9\,m^3$, and this accounts for 99% of all water use (Qureshi, 2002). Accordingly, Afghanistan's water resources have the potential to irrigate more land than is currently being irrigated. Increasing the cultivation area will result in increased production, which will lead to food security and an improved economy.

Output from irrigated agriculture is twice or three times that from rain-fed agriculture. Furthermore, irrigated areas are extremely important in Afghanistan and have been able to maintain a certain level of productivity during periodic droughts while other areas suffered from devastating losses of crop production. However, rehabilitation of irrigation systems is also needed, and the introduction of an effective irrigation plan that can deal with water shortages in summer could result in significantly improved outcomes (Kawasaki, *et al*., 2012).

2.3 Arable land

Afghanistan has about 8×10^6 ha of arable land, which is 12% of the total land area. However, only around 3.9×10^6 ha are currently cultivated, of which 1.3×10^6 ha is rain fed and 2.6×10^6 ha is irrigated. This irrigated area accounts for almost 85% of all agricultural production (Qureshi, 2002). Based on

these numbers, Afghanistan can potentially expand its agricultural area by 100%, which will dramatically increase employment. Through expansion of arable land, the country will produce sufficient food for its population and could even export to neighboring countries, which will contribute to both food self-sufficiency and economic growth.

2.4 Urban horticulture

Urban horticulture is defined as plant production activities that are conducted in a city or suburb that produce plants that are wholly or partially edible, and are economically viable. In a broad sense, urban horticulture includes home vegetable gardens, community farms, rooftop and wall greening, park and city greening, and similar activities (Ohyama, *et al*., 2008).

Even though the majority of produce grown in urban areas in developing countries goes to subsistence, there are other incentives for urban Horticulture. Some high-income inhabitants of urban areas use horticulture as a strategy for further accumulation of wealth through the production of high-yield crops close to the market. Some middle-income inhabitants use urban horticulture to secure their family's well-being. The urban poor rarely have access to farming plots large enough to support the whole family with food. Consequently, urban Horticulture generally serves as a vital source of supplementary income for many households. Since most of the produce of urban horticulture is used for subsistence consumption, it can be difficult to assess the impact of urban horticulture on the economy; however, there is little doubt that urban horticulture creates considerable economic activity in the cities (Bryld, 2003).

Urban horticulture can also improve the environment, because the areas of production and consumption are close to each other. Urban horticulture is thus expected to reduce the amount of CO_2 emission caused by transportation of produce and hence is environmentally friendly (Ohyama, *et al*., 2008). One of the most efficient ways of improving the environment is through recycling of organic waste. Compost from urban organics can easily be applied in urban and peri-urban plots as surface mulches and as fertilizer (Bryld, 2003). In Afghanistan, urban horticulture can also be considered a good opportunity to convince people to grow horticultural products. For example, kitchen gardening, which provides people with fresh and diverse vegetables, will improve food security and contribute to the family economy. If a family owns a kitchen garden, it will provide all or some of their needs for fresh vegetables, thus they spend less money or even no money to buy fresh vegetables.

2.5 Home-based processing

Home-based processing helps to reduce post-harvest losses; it enables households to sell their produce after the harvest season, when prices are higher. It also allows farmers to transport their produce to distant markets without excessive losses due to spoilage, and provides access to markets where they can obtain better prices for their produce. Home-based fruit processing is particularly beneficial for households living in remote areas, far from markets.

Many Afghan families already use simple food storage and processing techniques such as drying fruits and vegetables or making pickles. However it is possible to help them improve the quality of their processed foods. Home-based food processes cover more than just preparation and cooking of the raw products; they include a range of simple processes that can be used to preserve fruits and vegetables for later use. These processes do not require expensive or complicated equipment and can be used at home (Ali, 2008), which will result in:

a. Reduced post-harvest losses.
b. Increased food security.
c. Potential to earn income by selling products in local markets.

The most suitable processes and products for small-scale preservation of fruits and vegetables are as follows:

a. Drying
b. Making jams, chutney (sauces), achar (pickles), vinegar

Importance of horticulture

Not only is horticulture of great economic importance, it also fulfils important social functions (Bogers, 2006). "Trees, grass, and gardens, by their presence and by their visibility, have been found to increase people`s general life satisfaction in urban settings, reduce irritability and mental fatigue, and restore calm" (Hynes and Howe, 2004).

Horticulture in Afghanistan faces several challenges, as described earlier in this paper, but opportunities also exist that result from improvements in the production chain. To meet future expectations, the maintenance of an adequate knowledge base and close contact between educators, researchers, government, producers,

processors, distributors, and retailers are essential. The greatest problem facing horticulture in Afghanistan is the lack of knowledge that results from a lack of contact between educators, researchers, and growers. The growers do not know the most recently developed pre- and post-harvest techniques to preserve the quality of their produce.

Trainer training will be an important factor in sustaining horticultural education. If five trainers could be trained by one person, after five cycles of this approach, 3125 people will have been trained (Sarhadi, *et al*., 2014).

The lack of any significant modernization of Afghan horticulture over last 30 years, and the historical and environmental opportunities of the country, provide Afghanistan with an unusual advantage to develop a modern and competitive horticulture sector. Afghanistan can now benefit from the lessons, skills, and knowledge from the developed world. This will allow production of unique and high-quality horticultural products.

Horticulture clearly plays a crucial role in the Afghan economy, and is necessary for the establishment and improvement of the rural economy. Providing market information to farmers and export criteria to traders will help both farmers and traders gain more profit. This will result in progress towards sustainable horticulture and a better economy. Afghan farmers are showing an increased interest in production of cash crops. Cash crops offer an economic advantage over the production of subsistence crops (Kemal-ur-Rahim, 2003). However, horticultural crops are the best option to support food security and rehabilitate the rural economy in Afghanistan because:

a. Most farmers are familiar with horticultural crops.
b. Horticultural crops can be grown in different agro-ecological zones, even under closed or protected environments (e.g., greenhouses outside the usual growing season).
c. Horticulture generates a high income.
d. Home-based processing of horticultural products diversifies family income.

An important traditional consideration that affects the viability of horticulture is poppy cultivation. Currently there is strong international pressure on the Afghan government to reduce poppy cultivation. However, the success of this will depend on viable alternatives that can sustain the rural economy. Alternatives to poppy cultivation are urgently needed. However, poppy cultivation shares many similarities with horticulture: both are labor-intensive, and horticulture requires very similar knowledge to that required for the cultivation of poppies. Many horticultural crops offer viable economic alternatives for poppy farmers. In addition to the viability of horticultural crops, development of national and international markets is also needed for horticultural products.

Conclusions

Agriculture - mainly horticulture - played a crucial role in the economy of Afghanistan before the years of warfare. This paper has discussed the challenges and opportunities facing horticulture in Afghanistan. Horticulture can once again contribute toward a sustainable economy. Afghanistan has the potential to produce its own food and even to export food. Rebuilding horticulture and investing in this field can also reduce poppy cultivation if the markets, storage, processing, and other challenges facing horticultural products are solved.

Basic horticultural and agricultural knowledge and skills will play an important role in the development of this sector. Afghan farmers do not have access to national and international markets. Therefore, providing market information to farmers is an important part of overcoming this challenge.

Horticulture can contribute to increasing rural incomes and employment opportunities. This sector can contribute toward poverty reduction by providing employment and wages to laborers. Greater employment opportunities will result in greater incomes for poor households. Labor demand will also rise in the post-harvest sector, since transport, packaging, sorting, grading, and cleaning are all labor-intensive activities.

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References

Ali, S.A., 2008. Home-based Fruit and Vegetable Processing in Afghanistan. A Manual for Field Workers and Trainers. Book One: Principles of post-harvest handling, storage and processing of fruits and vegetables. Food and Agriculture Organization of the United Nations (FAO) and Ministry of Agriculture, Irrigation and Livestock, Afghanistan, ftp://ftp.fao.org/docrep/fao/011/a1549e/a1549e01.pdf, accessed November 2015.

Bogers, R.P., 2006. The Future of Horticultural Science and Education: A European Perspective. Report. http://www.beneluxshs.eu/2006/report-the-future-of-horticultural-science-and-education-a-european-perspective/. Accessed November 2015.

Bryld, E., 2003. Potentials, problems, and policy implications for urban agriculture in developing countries. Agriculture and Human Values, 20, 79−86.

Bunnel, D., Safi, J., 2013. Afghanistan Raisin Annual. USDA Foreign Agriculture service. http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Raisin%20Annual_Kabul_Afghanistan_8-1-2013.pdf, accessed November 2015.

Central Statistics Organization (CSO), Afghanistan 2012. Afghanistan Statistical year book 2011−2012. Islamic Republic of Afghanistan, pp. 140.

De Soysa, I., Gleditsch, N.P., Gibson, M., Sollenberg, M., 1999. To cultivate peace: Agriculture in a world of conflict. Oslo: International Peace Research Institute.

Erskine, W., Nesbitt, H., 2009. How can agriculture research make a difference in countries emerging from conflict? Experimental Agriculture 45, 313−321.

Food and Agriculture Organization of the United Nations (FAO), 2004. Afghanistan –Survey of the Horticulture Sector 2003. www.fao.org/docrep/007/y5163e/y5163e08.htm, accessed November 2015.

Future Harvest Consortium to Rebuild Agriculture in Afghanistan, 2003. Needs Assessment on Horticulture in Afghanistan. http://afghanag.ucdavis.edu/other-topic/markets/marketing-reports/Needs_Assess_on_Hort_ICARDA_1.pdf, accessed November 2015.

Hynes, H.P., Howe, G., 2004. Urban Horticulture in the contemporary United States: Personel and community benefits. Acta Hortic. 643, 171−181.

Kawasaki, S., Watanabe, F., Suzuki, S., Nishimaki, R., Takahashi, S., 2012. Current situation and issues on agriculture of Afghanistan. Journal of Arid Land Studies, 1, 345−348.

Kemal-ur-Rahim, K., 2003. A Review of the Horticultural Marketing and Post-Harvest Conditions in Afghanistan. OSRO/AFG/212/ITALY.

Sarhadi, A.W., Fahim, S.A., Tangutan, K., 2014. Sustainable agricultural development in Afghanistan. Journal of Developments in Sustainable Agriculture, 9, 41−46.

Ohyama, K., Takagaki, M., Kurasaka, H., 2008. Urban horticulture: its significance to environmental conservation. Sustainability Science, 3, 241−247.

Qureshi, A.S., 2002. Water Resources Management in Afghanistan: The Issues and Options. Working Paper 49. International Water Management Iinstitute.

The Inside Story on Emergencies, 2015. Tremendous potential for food self-sufficiency-FAO expert. http://www.irinnews.org/report/77814/afghanistan-tremendous-potential-food-self-sufficiency-fao-expert , accessed November 2015.

Saidajan, A., 2012. Effects of war on biodiversity and sustainable agricultural development in Afghanistan. Journal of Developments in Sustainable Agriculture 7, 9−13.

The World Bank group. Climate change knowledge portal - Afghanistan http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisRegion=Asia&ThisCCode=AFG, accessed November 2015.

Thompson, A.K., 2003. Fruit and Vegetables: Harvesting, Handling and Storage, Third edition, Willey-Blackwell, London, pp. 115−134.